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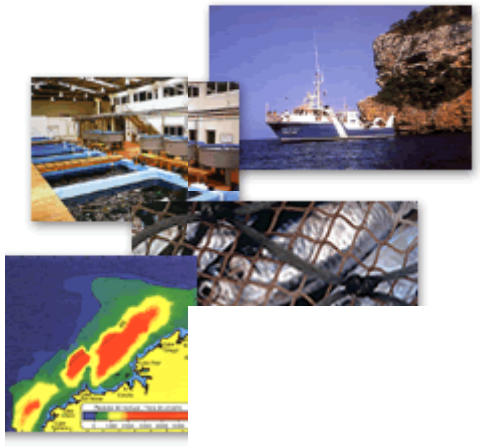


# IBERIAN-ATLANTIC CHUB MACKEREL. IEO's ACOUSTIC-TRAWL SURVEYS DATA UPDATE

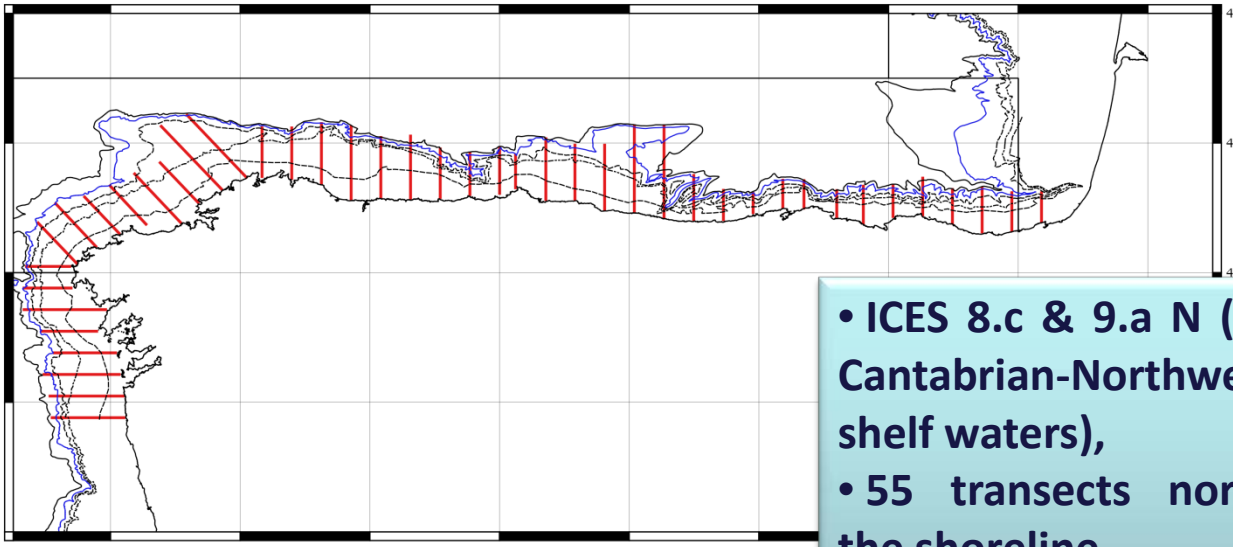
**Fernando Ramos & Pablo Carrera**
**IEO (C.O. Cádiz & C.O. Vigo)**

**ICES Workshop on Atlantic chub mackerel (*Scomber colias*), WKCOLIAS 2.**
**By WebEx,**
**25-29/01/2021**

GOBIERNO DE ESPAÑA
MINISTERIO DE CIENCIA E INNOVACIÓN

# *IEO's Acoustic Trawl surveys in Iberian-Atlantic waters.*

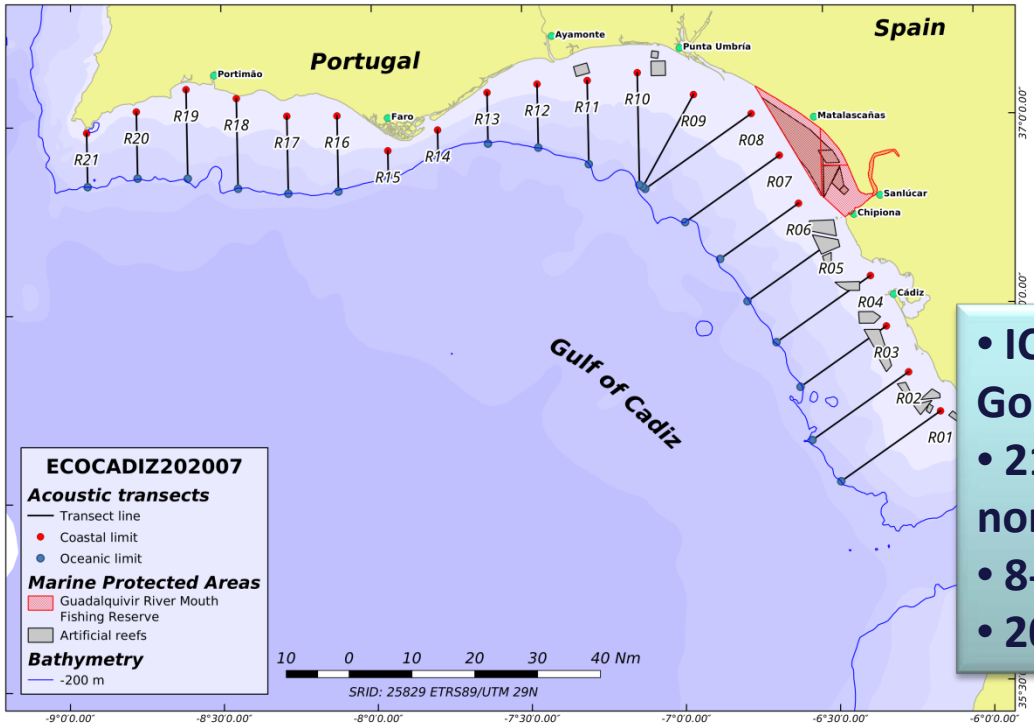
- ***PELACUS* surveys series:** Acoustic assessment (by echo-integration) and mapping of neritic fish resources and of the oceanographic and biological conditions off the Spanish Cantabrian-Northwestern continental shelf. (**In Spring**, March-April). ICES areas 8.c, 9.a N. Since 1991. R/V *Miguel Oliver* since 2013 on. 25 days. **NO SURVEY IN 2020 BECAUSE COVID-19 DISRUPTION**.




- **ICES 8.c & 9.a N (Spanish Cantabrian-Northwestern shelf waters),**
- **55 transects normal to the shoreline,**
- **8-nm interspaced,**
- **20 – 1000 m depth.**

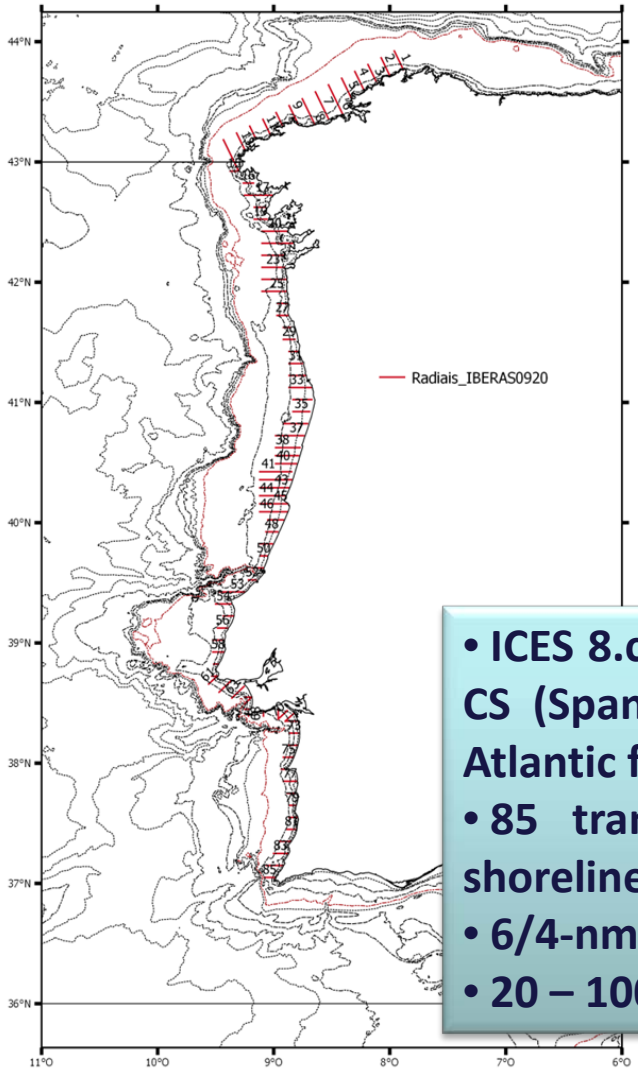
# *IEO's Acoustic Trawl surveys in Iberian-Atlantic waters.*

- ***ECOCADIZ* surveys series:** Acoustic assessment (by echo-integration) and mapping of neritic fish resources and of the oceanographic and biological conditions off the Gulf of Cadiz continental shelf. (**In Summer**, July-August). ICES 9.a S. Since 2004. R/V *Miguel Oliver* since 2014 on. 14 days.




- **ICES 9.a South (PT & ES GoC shelf waters),**
- **21 transects, normal to the shoreline,**
- **8-nm interspaced,**
- **20 – 200 m depth.**

# *IEO's Acoustic Trawl surveys in Iberian-Atlantic waters.*



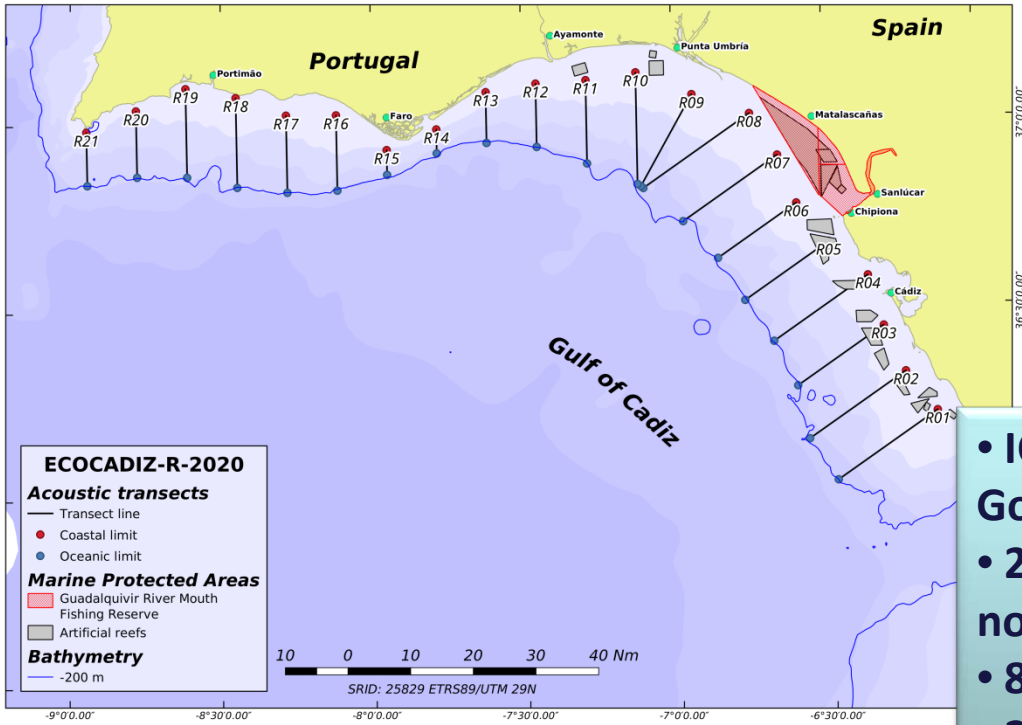

- ***IBERAS* surveys series:** Acoustic assessment (by echo-integration) and mapping of neritic fish resources and of the oceanographic and biological conditions off the Spanish-Portuguese Iberian-Atlantic façade shelf waters (sardine & anchovy juveniles survey). (**In Autumn**, (Nov in 2018) September). ICES areas 8.c W*, 9.a N-CS. Since 2018. R/V *Ramón Margalef*. 20 days.

**• ICES 8.c W*, 9.a N, 9.a CN, 9.a CS (Spanish-Portuguese Iberian Atlantic façade shelf waters),**
**• 85 transects normal to the shoreline (+23 in rías),**
**• 6/4-nm interspaced,**
**• 20 – 100 m depth.**

* Only in 2020

# *IEO's Acoustic Trawl surveys in Iberian-Atlantic waters.*

- ***ECOCADIZ-RECLUTAS* surveys series:** Acoustic assessment (by echo-integration) and mapping of neritic fish resources and of the oceanographic and biological conditions off the Gulf of Cadiz continental shelf (sardine & anchovy juveniles survey). (**In Autumn**, October). ICES 9.a S. Since 2012 (since 2014 on for the whole GoC). R/V *Ramón Margalef*. 20 days.




- **ICES 9.a South (PT & ES GoC shelf waters),**
- **21 transects, normal to the shoreline,**
- **8-nm interspaced,**
- **20 – 200 m depth.**

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# *IEO's Acoustic-Trawl surveys in Iberian-Atlantic waters : Main objectives.*

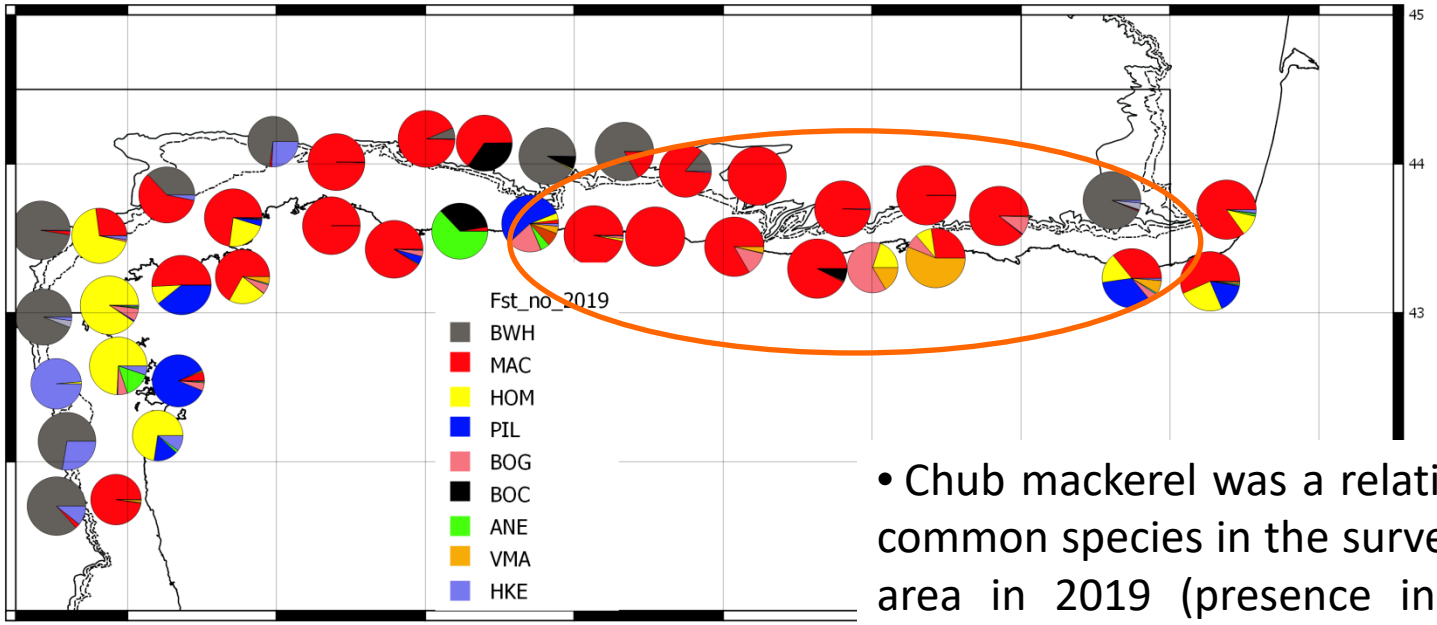
- **ALL**: acoustic assessment (by echo-integration) and mapping of neritic fish resources and of the oceanographic and biological conditions off the surveyed area (***PELACUS*** & ***ECOCADIZ*** : EK 60 multifreq.; ***IBERAS*** & ***ECOCADIZ-RECLUTAS***: with special reference to Age 0 anchovy and sardine juveniles in autumn surveys. EK 80 multifreq.).
- **ALL**: Biological characterization of assessed fish species.
- ***PELACUS*** & ***ECOCADIZ***: delimitation of the extension of the sardine & anchovy spawning grounds in the surveyed area (CUFES sampling): sardine & anchovy spawning habitats (eggs & adults & environment).
- ***PELACUS*** & ***ECOCADIZ (& IBERAS)***: Mapping of the distribution and abundance of top predators.
- ***PELACUS*** & ***ECOCADIZ*****:** Mapping of the distribution of the abundance and biomass of marine litter and micro-plastics.
- **ALL:** Hydrological characterization of the surveyed area (CTD/LADCP/VMADCP & ThermoSal).

# IEO's Acoustic Trawl surveys in Iberian-Atlantic waters: Estimation method.

- **Echogram post-processing software**: Echoview.
- **ESDU**: 1 nm.
- **Scrutinisation methodology**: Multi-frequency tools (plankton *vs* fish mask); Allocation of acoustic energy by species according to species composition of hauls + Manual allocation (Expert judgment (occasional)). Echo-integration exported by schools (***PELACUS***, ***IBERAS***) or regions (***ECOCADIZ***, ***ECOCADIZ-RECLUTAS***).
- **TS** (b20): -68.7 (Lillo *et al.*,1996).
- **Length indicator used in the TS-length equation**: whole LFD according to Nakken and Dommasnes (1975, 1977) method.
- **Abundance and biomass estimation**: by coherent post-stratum (homogeneity in LFD according to K-S test results) by size class and age group (if an ALK is available). No estimation error is computed.

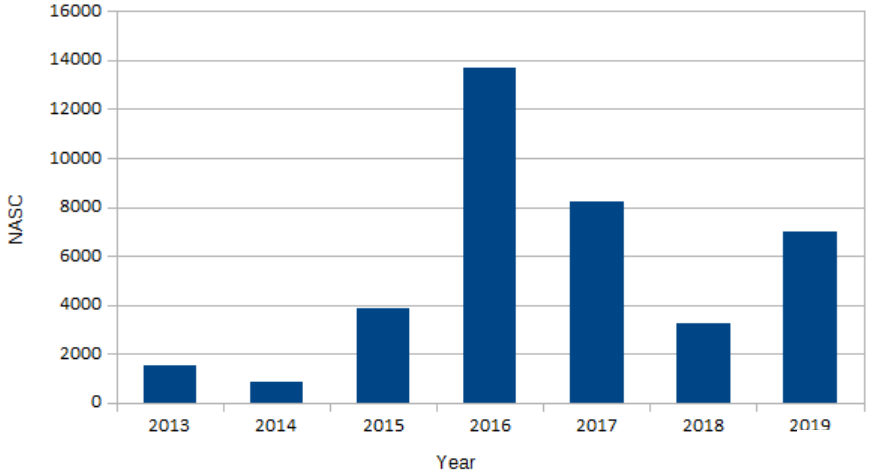
# *PELACUS surveys series.*
# *PELACUS 0319.*

# PELACUS surveys series: Fishing hauls. VMA relative frequency of occurrence (presence index). PELACUS 0319.

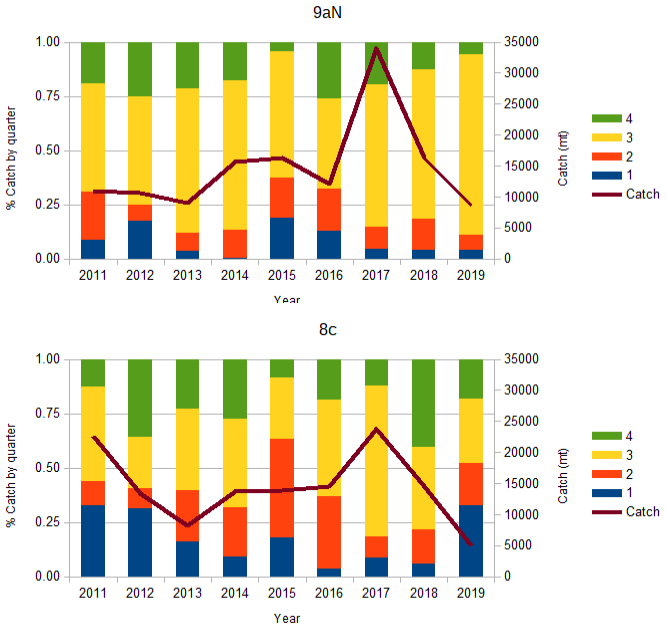



- Chub mackerel was a relatively common species in the surveyed area in 2019 (presence index: 43%), but occurred almost exclusively in the eastern part of the surveyed area.

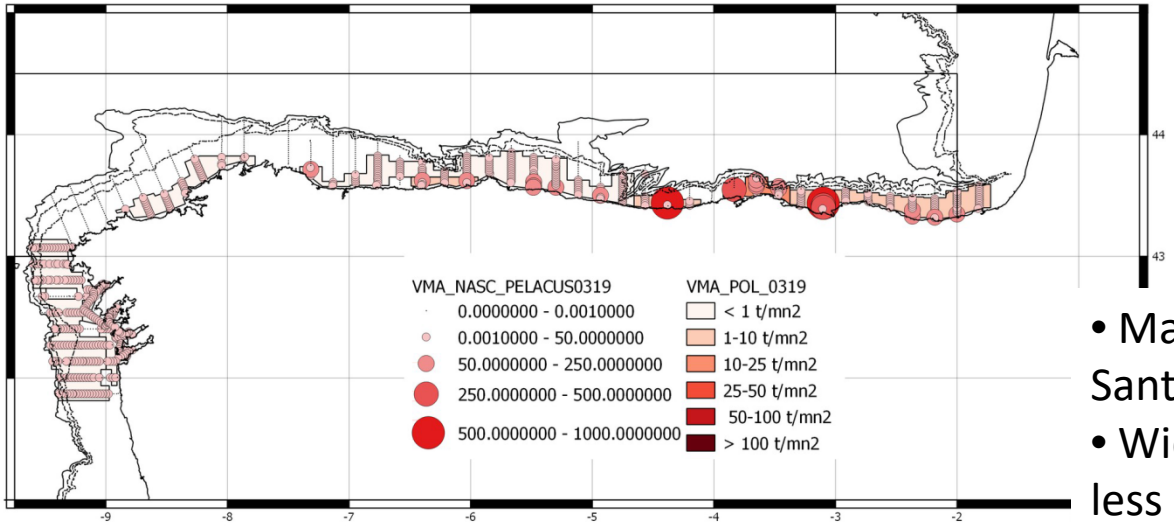
# PELACUS surveys series: VMA NASC historical series.

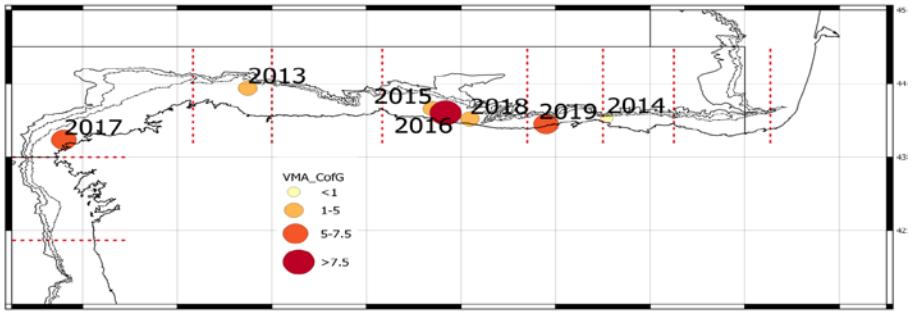



- Chub mackerel should be considered so far as a secondary species within the early spring SPF "acoustic population".
- Contributions to the total NASC < 3% in last years.
- 2018-2019 two-fold increase.
- Higher acoustic densities in the eastern part (ICES 8.c East). In 9.a N in 2017.
- Scarce availability in spring time in 9aN, fishery in 3rd Q



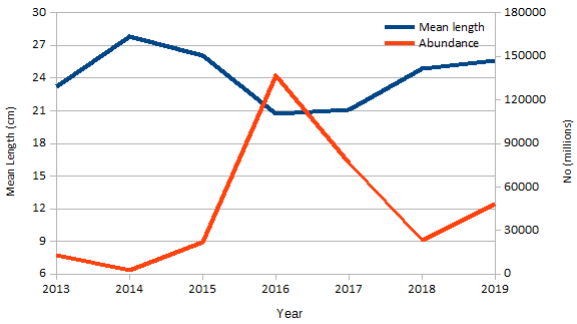
# PELACUS surveys series: VMA NASC distribution pattern.

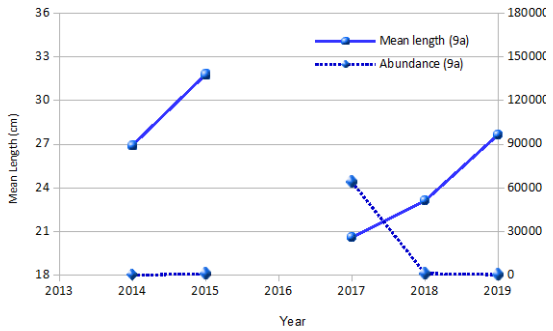


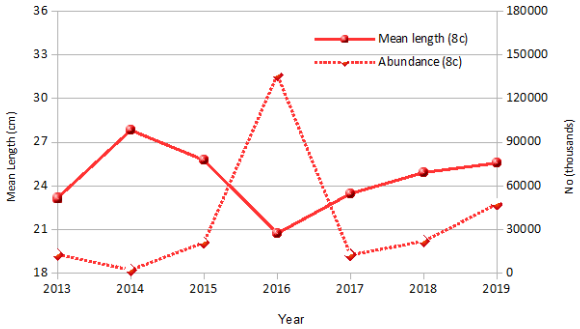



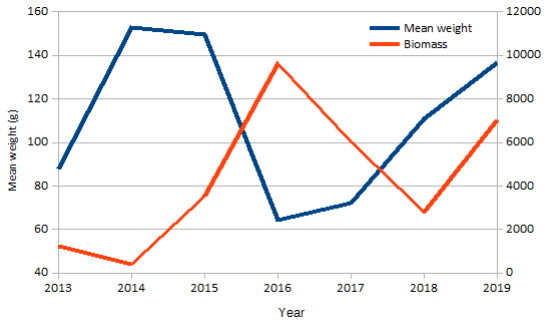

- Main concentrations near Santander.
- Wider distribution in 9.a N but less dense than in the eastern part.
- Centre of gravity shifting towards the eastern part again in 2019.

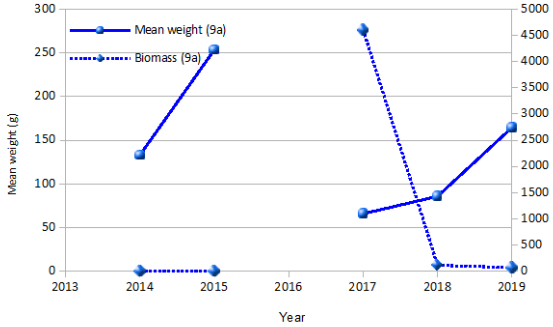
# PELACUS surveys series: historical series of VMA N and B estimates.

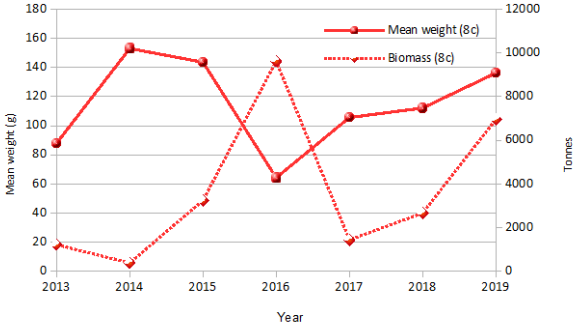


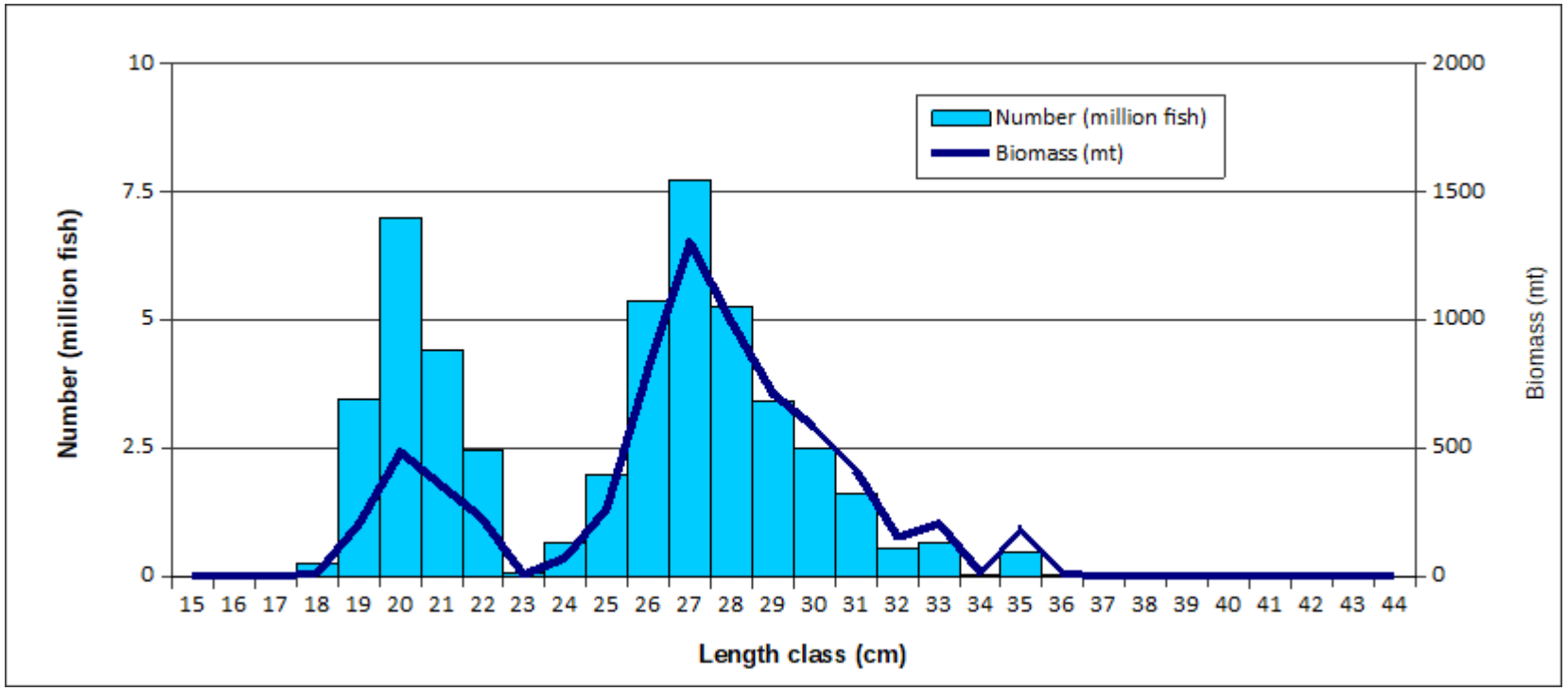



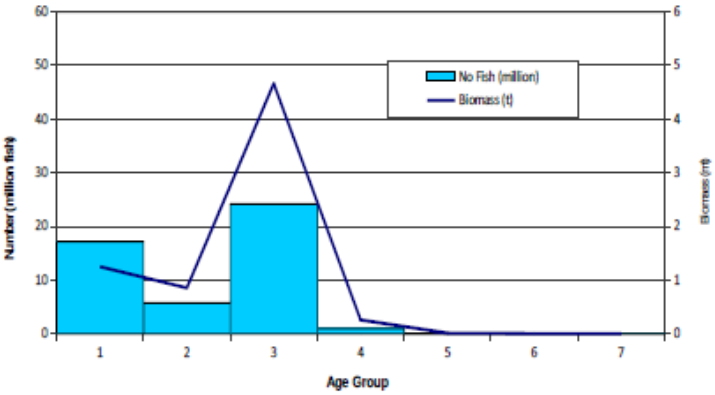

- Total area: Peak in 2016. Decreasing trend since then. 2019: 48 millions, 7025 t.
- 9.a N: very scarce presence in early spring. Only relevant in 2017.
- 8.c: constant presence.

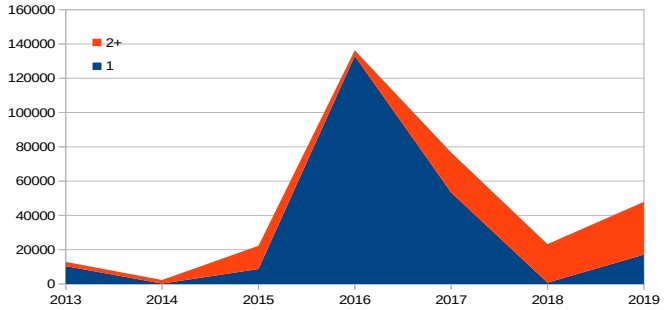
# PELACUS surveys series: VMA population size composition.

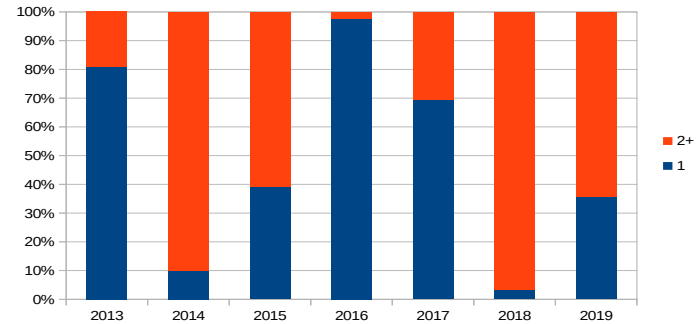



- Overall size class range in 2019: 18.0 – 38.0 cm.
- 2 modes: 20.0 cm & 28.0 cm (the dominant one).

# PELACUS surveys series: VMA population age structure.



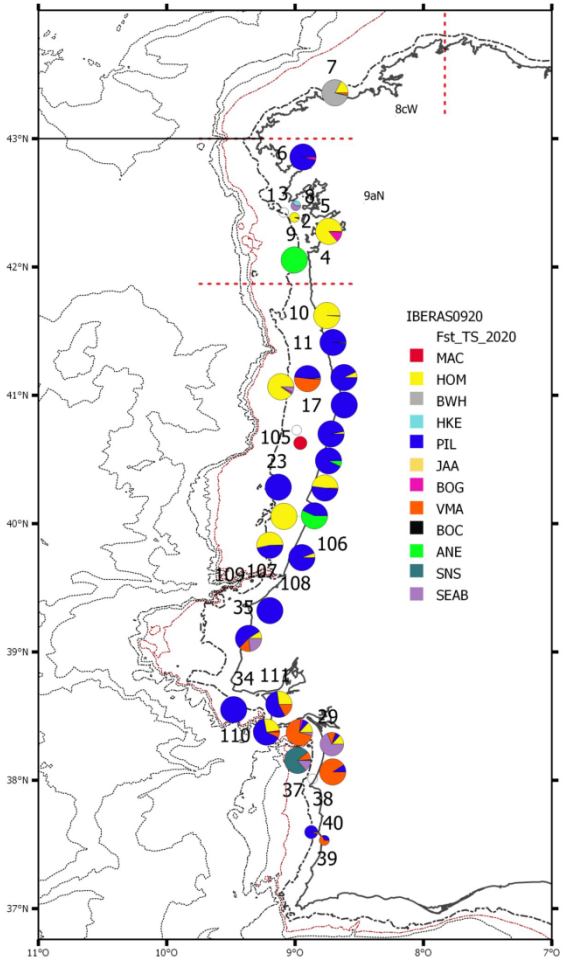




- Age 1 – Age 7 groups present in the population.
- Age 1 – Age 3 the main ones.
- Age 1 dominant in 2013, 2016 and 2017. Cohorts well tracked.
- Strong 2012, 2015 and 2016 year classes.
- Mean size and weight of the population influenced by the dominant younger age groups.

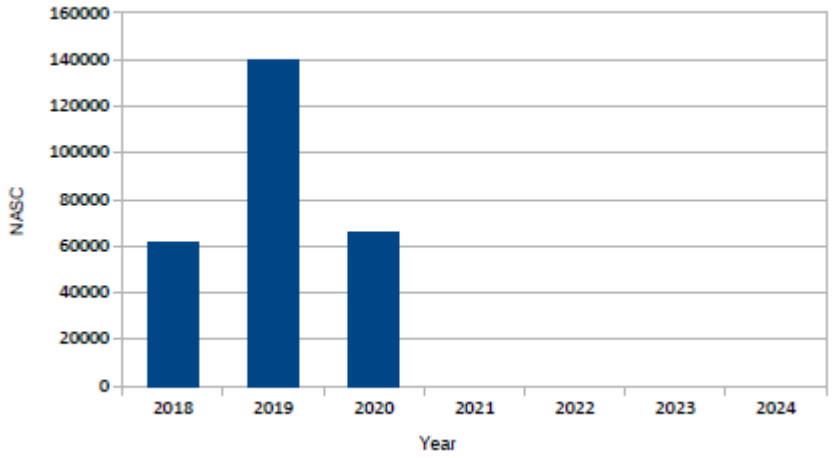
# *IBERAS surveys series.*
# *IBERAS 0920.*

# IBERAS surveys series: Fishing hauls. VMA relative frequency of occurrence (presence index). IBERAS 0920.



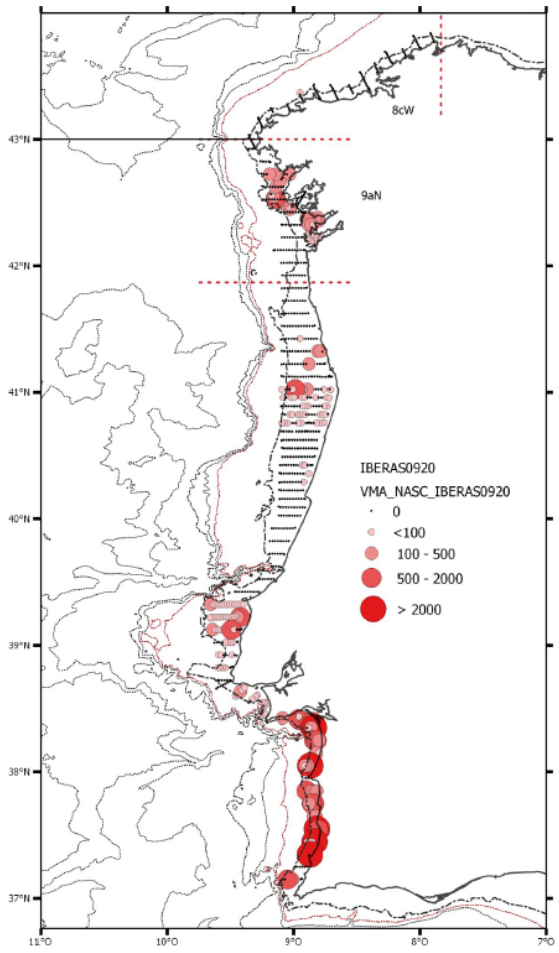

- Chub mackerel was a relatively common species in the surveyed area in 2020 (presence index: 58%). Very frequent in the 9.a C-S (Alentejo area).

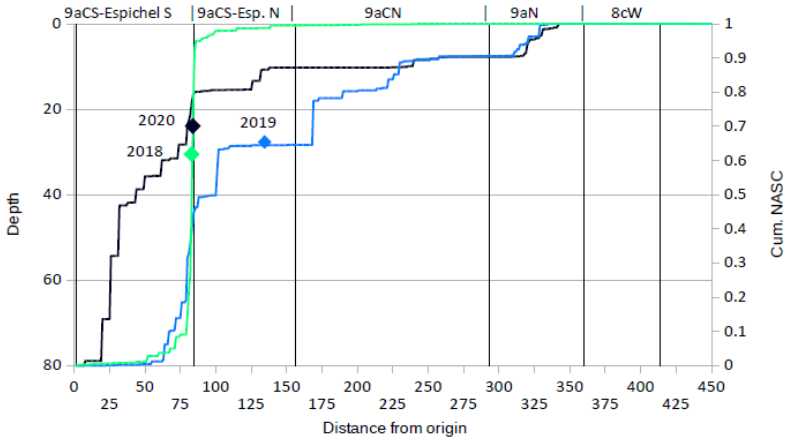
# IBERAS surveys series: VMA NASC historical series.




- 2018-2019 increase detected in early spring in 9.a N & 8.c (*PELACUS*) also detected by *IBERAS* in autumn in the Iberian Peninsula Atlantic façade.
- NASC decrease in 2020.
- Higher acoustic densities in the southern part (ICES 9.a Central-South).

# IBERAS surveys series: VMA NASC distribution pattern.

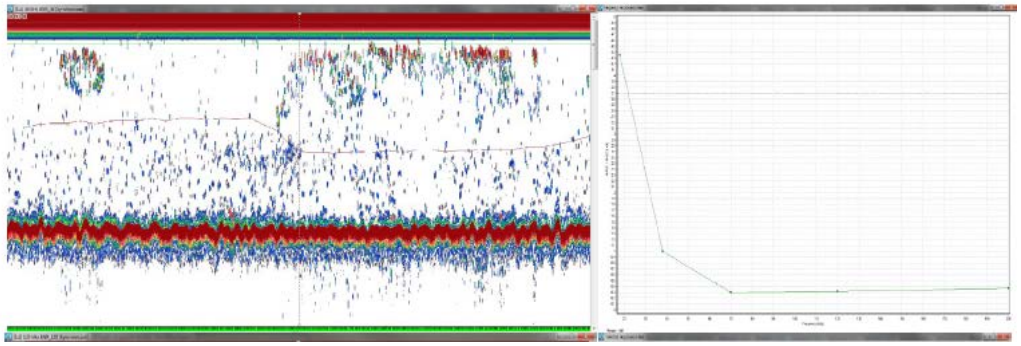


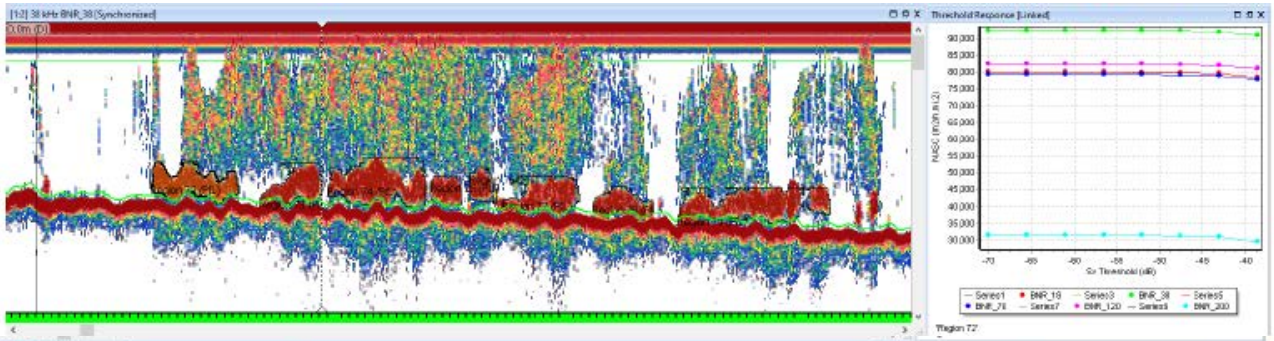

- Wide but patchy distribution, with a gap around the Spanish-Portuguese border (Minho River).
- Higher density in the southern area (9.a C-S).
- Centre of gravity shifting towards the southern part again in 2020. "Hibernating" in southern areas?

# IBERAS surveys series: VMA NASC distribution pattern.

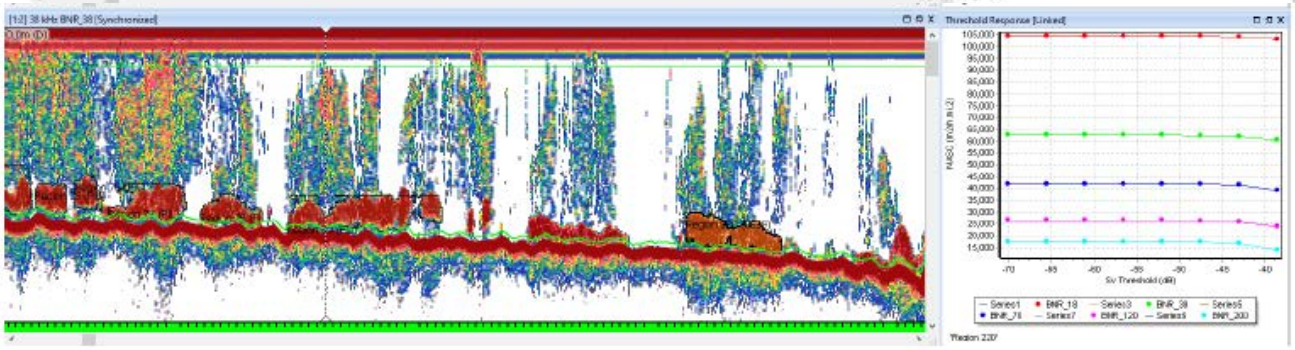
- Also important changes in the aggregation pattern (in 9.a C-S):



- 2019: not dense and <u>wide</u> epipelagic aggregations.

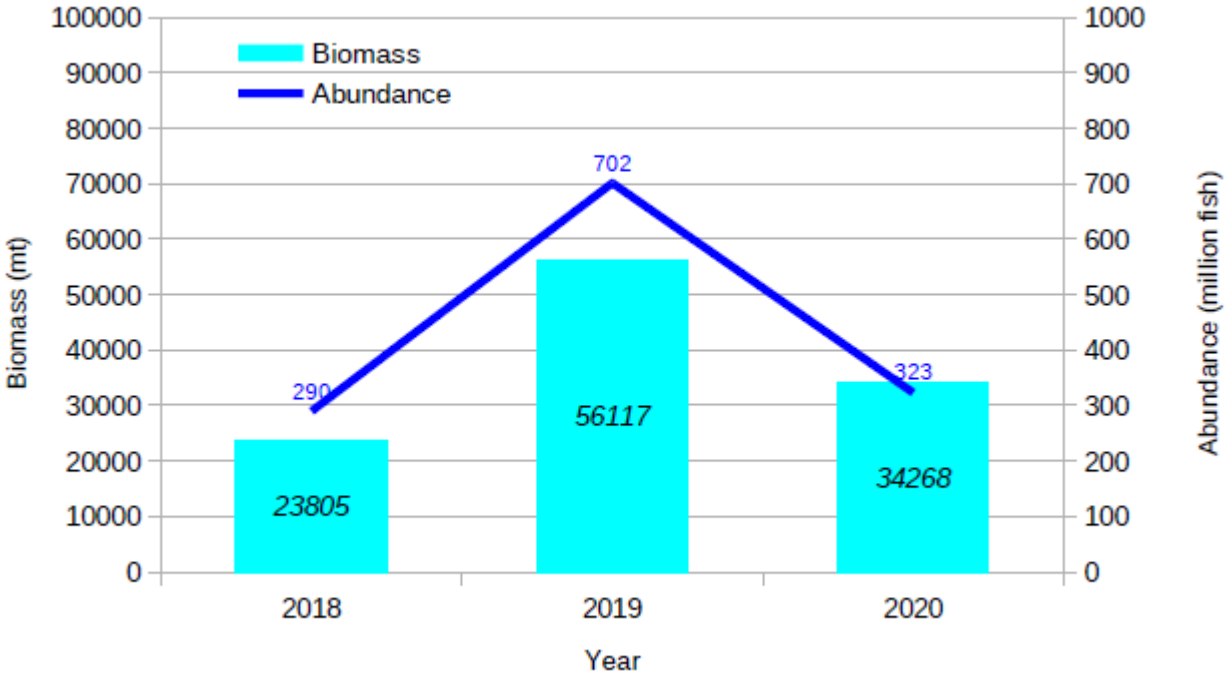


- 2020: <u>patchy</u>, very thick and dense, near bottom aggregations. May be mixed with sardine schools.



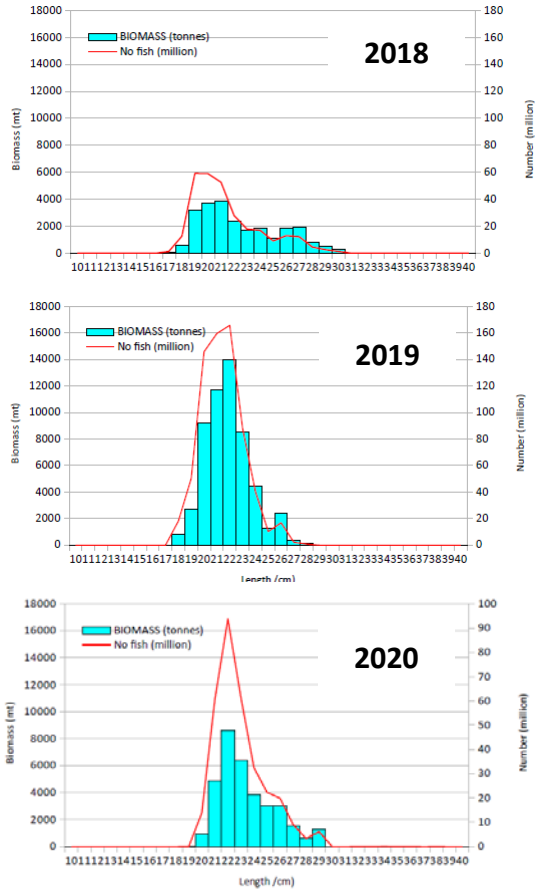
Exceptional or common patterns? <u>Studies are needed</u>.

# IBERAS surveys series: historical series of VMA N and B estimates.




- Very short time-series as to identify any trend.
- Maximum of biomass in 2019 probably due to a greater availability than in 2020 (different aggregation patterns).

# IBERAS surveys series: VMA population size composition.

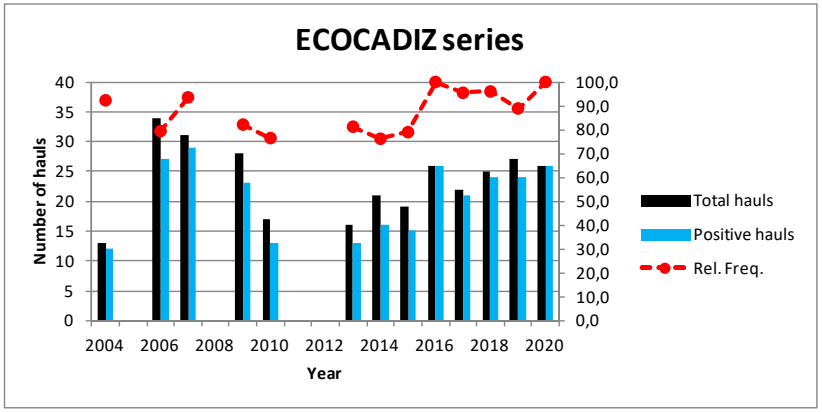


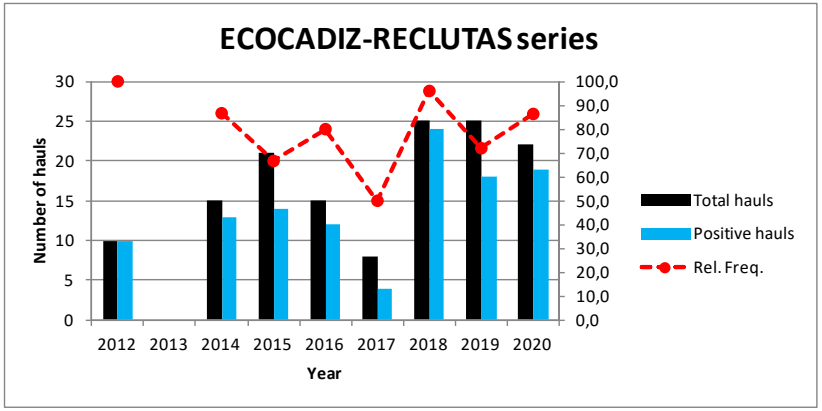

- Similar size class ranges: 18.0 – 38.0 cm.
- Similar mode: at 22.0 cm.
- Modes in 2020: south: 22 cm; north: 25 cm.

- No age structure of the population estimate is still available.

# *ECOCADIZ & ECOCADIZ-RECLUTAS surveys series. ECOCADIZ 2020-07 & ECOCADIZ-RECLUTAS 2020-10.*

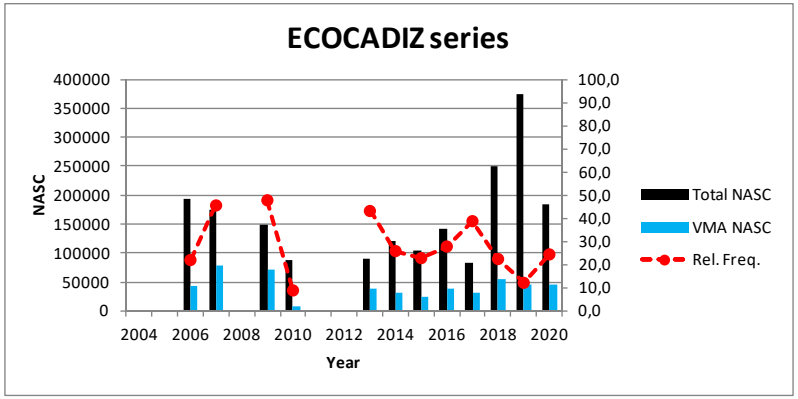
# ECOCADIZ & ECOCADIZ-RECLUTAS surveys series: Fishing hauls. Relative frequency of occurrence (presence index).

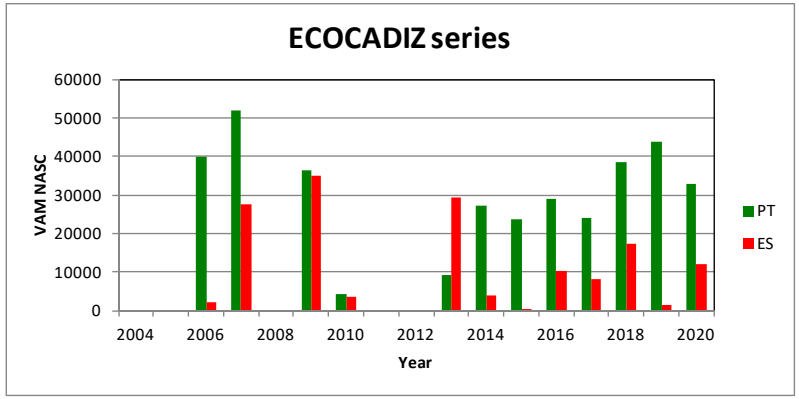


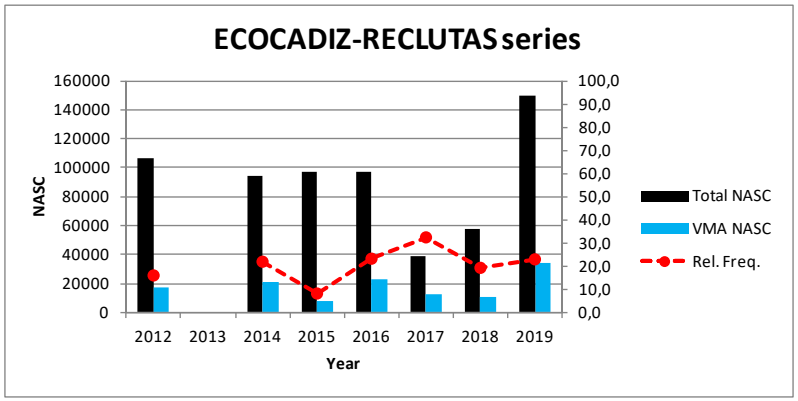



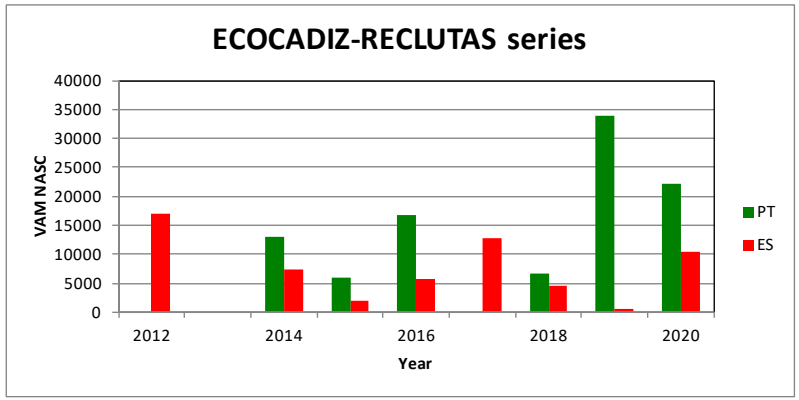

- Chub mackerel is a common species in the surveyed area, both in summer and in autumn, as evidenced by its high presence index in the ground-truthing hauls (mean presence index: 87% in summer, 80% in autumn).

# ECOCADIZ & ECOCADIZ-RECLUTAS surveys series: NASC historical series. Annual & regional relative importance.



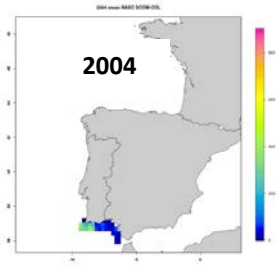



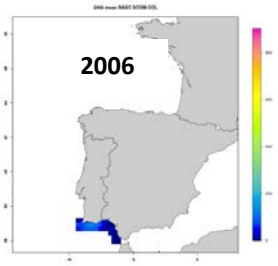



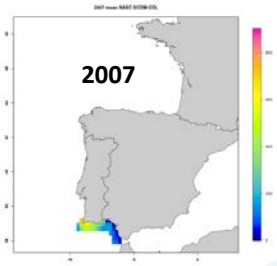

- Chub mackerel is an important species within the GoC "acoustic SPF assemblage".
- Average relative contributions to the total NASC:
  - ✓ 30% in summer.
  - ✓ 18% in autumn.

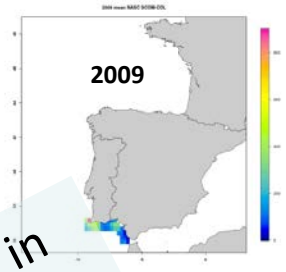
- Higher acoustic densities in Portuguese waters.
- PT average relative contributions to the total NASC:
  - ✓ Summer: 73%.
  - ✓ Autumn: 73%.

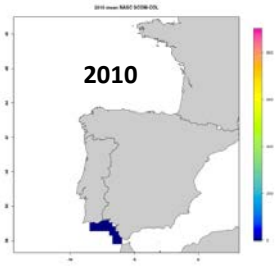
# ECOCADIZ & ECOCADIZ-RECLUTAS surveys series: NASC distribution pattern. ECOCADIZ surveys (summer). WGACEGG grid maps.

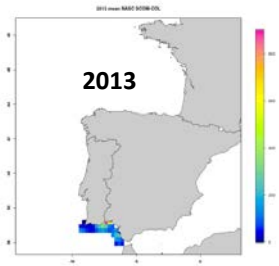


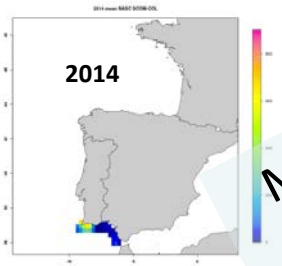



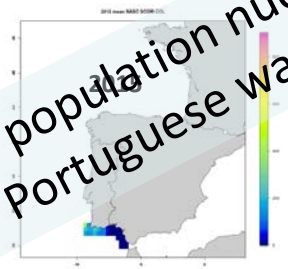



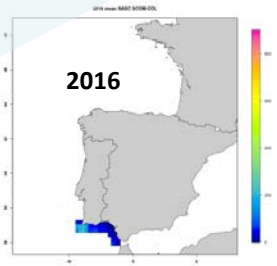



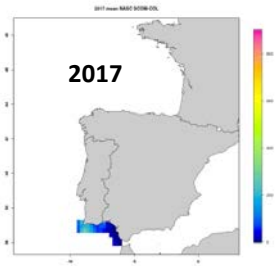



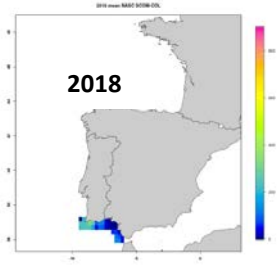



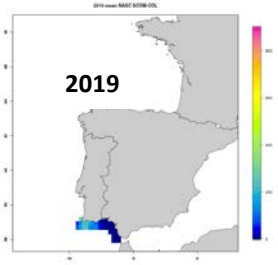



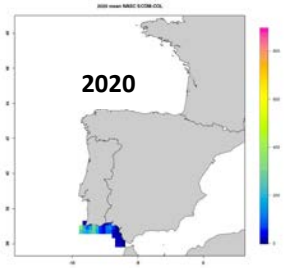



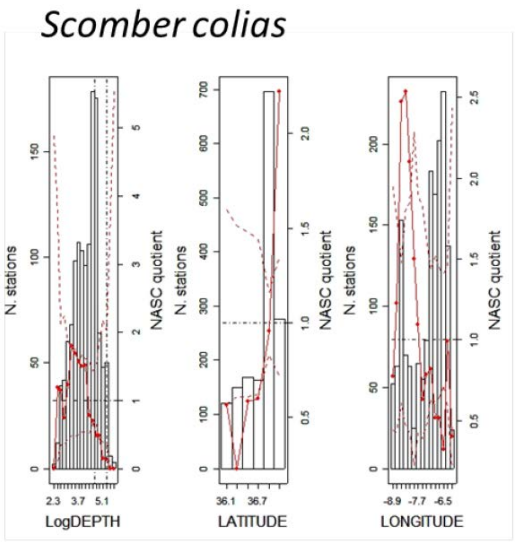



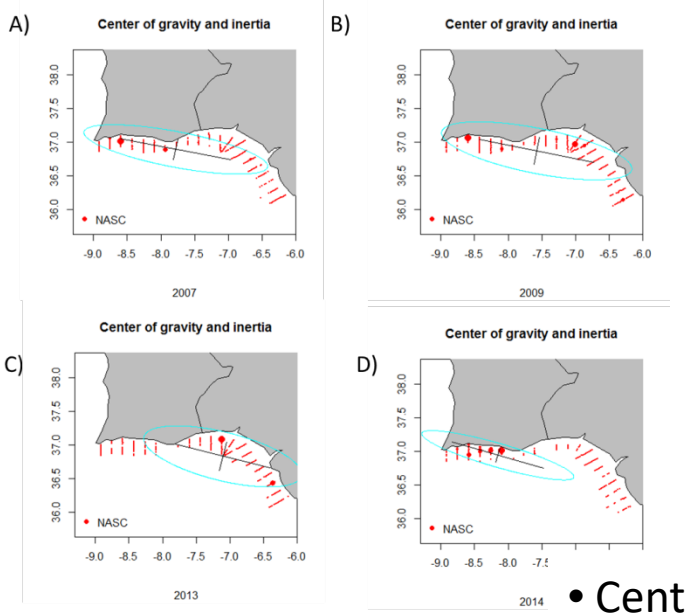



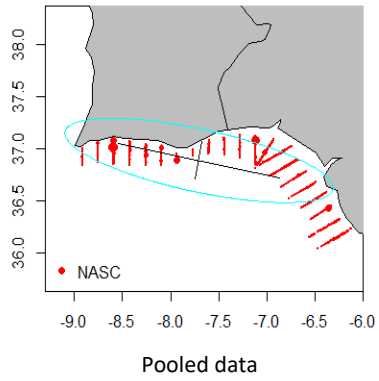




Main population nucleus in Portuguese waters

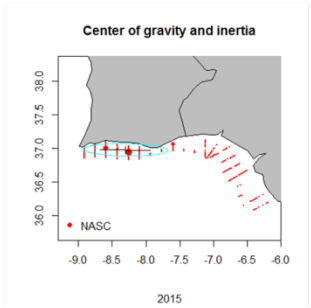
# ECOCADIZ & ECOCADIZ-RECLUTAS surveys series: NASC distribution pattern. ECOCADIZ surveys (summer). Canseco (2016).



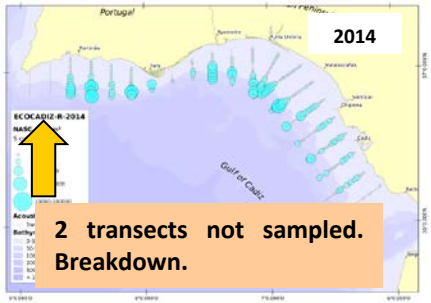



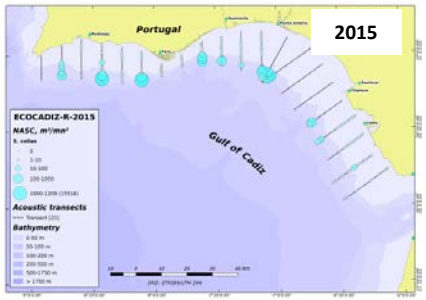

- Quotient Analysis (Lat, Long, Depth):
  - Preferences for:
    - 20-90 (120) m depth.
    - 8.5 W (Portimão, R19) – 7.0 W (Pta. Umbría, R09).



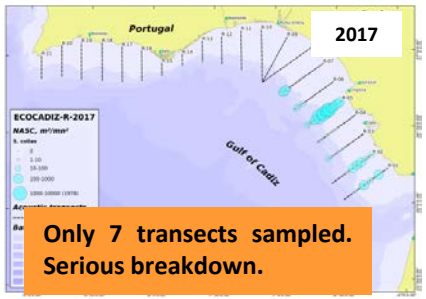

- Centre of Gravity & Inertia:
  - Inter-annual variation.
  - Overall preference for Portuguese waters.
  - Some reduction in the spatial distribution range through the analysed period (2007-2015)

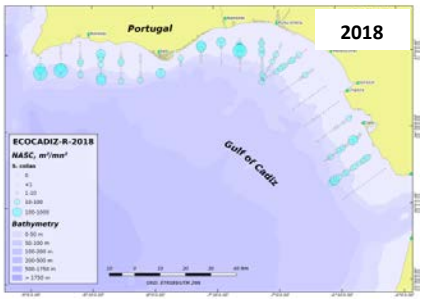
# ECOCADIZ & ECOCADIZ-RECLUTAS surveys series: NASC distribution pattern. ECOCADIZ-RECLUTAS surveys (autumn).

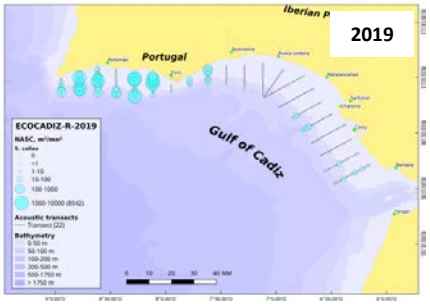



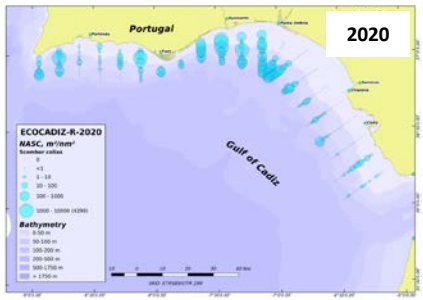







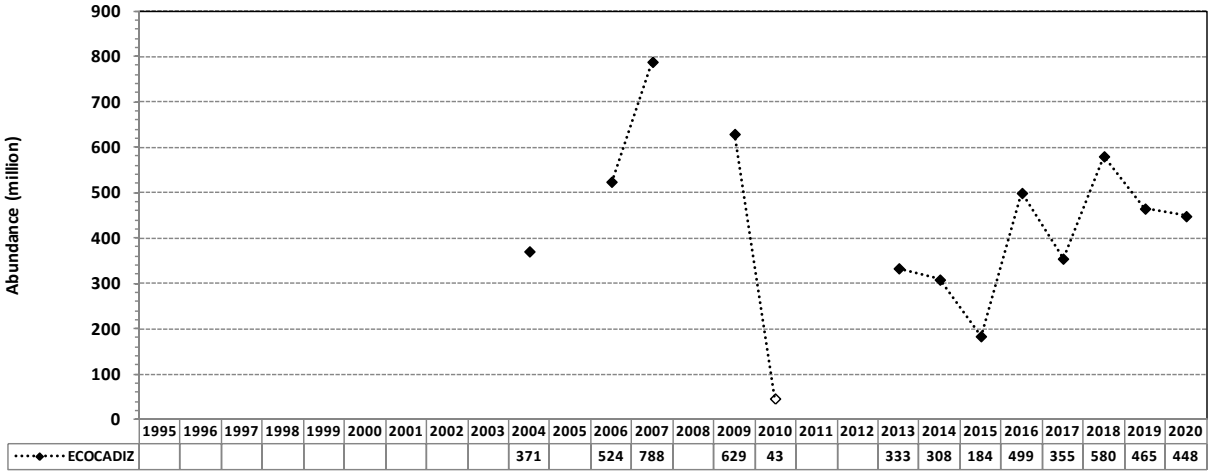




Autumn pattern still resembles the summer one.

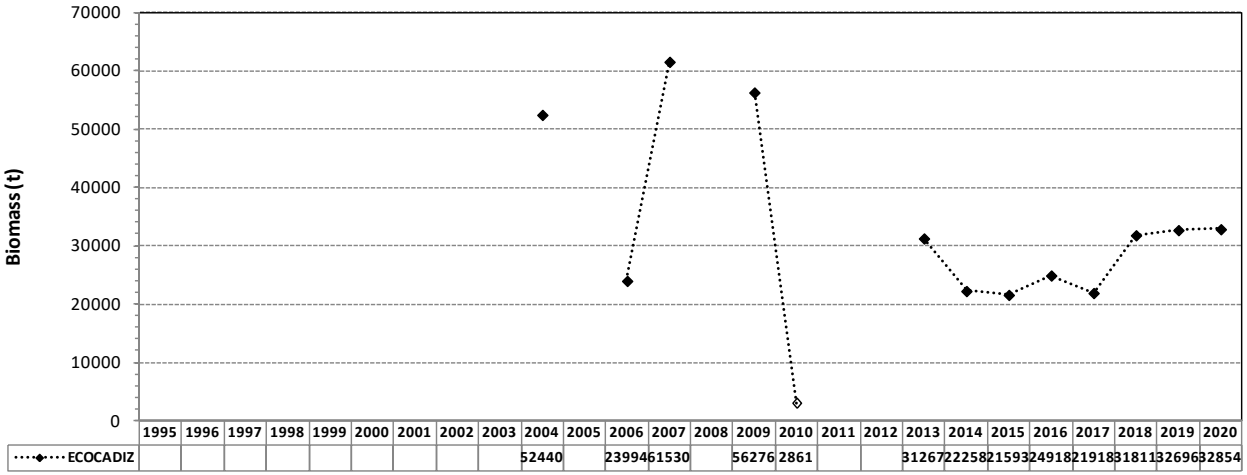
# ECOCADIZ & ECOCADIZ-RECLUTAS surveys series: historical series of N and B estimates. ECOCADIZ surveys series.

**ECOCADIZ surveys. Abundance estimates**




| | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ECOCADIZ | | | | | | | | | | 371 | | 524 | 788 | | 629 | 43 | | | 333 | 308 | 184 | 499 | 355 | 580 | 465 | 448 |

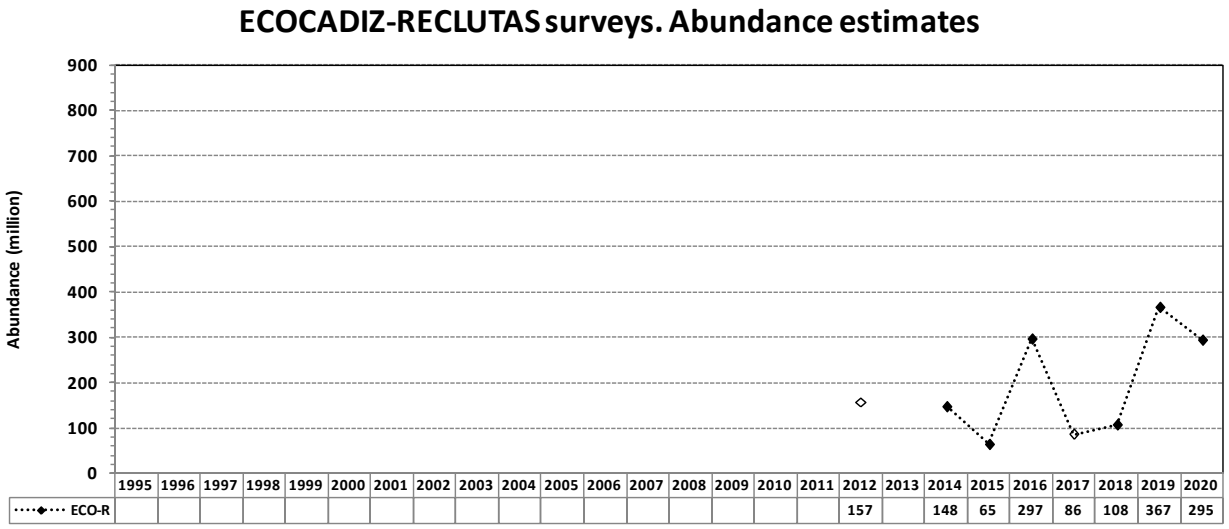
**ECOCADIZ surveys. Biomass estimates**

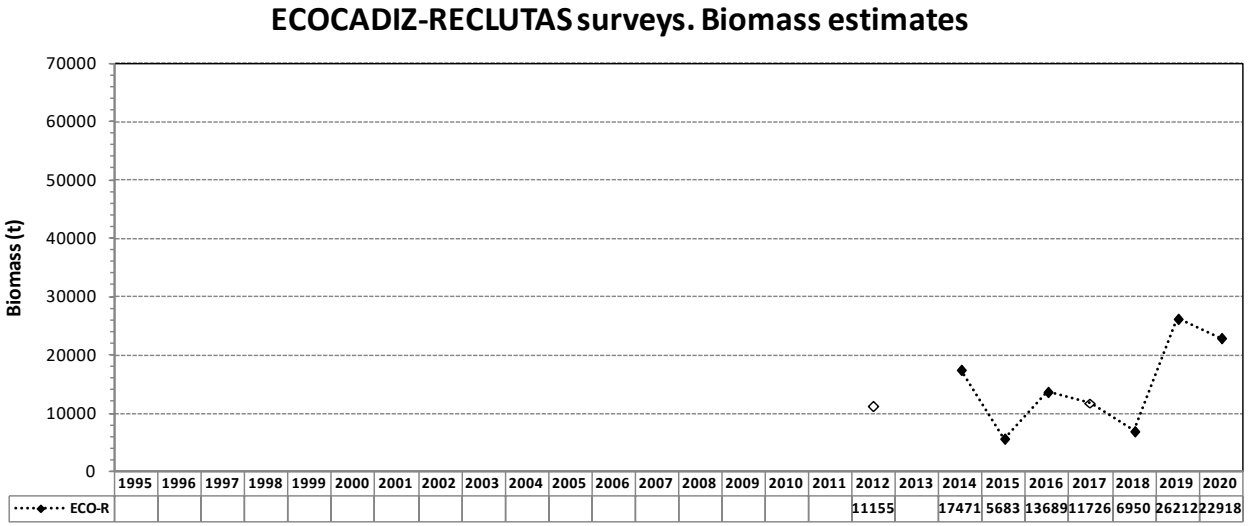



| | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ECOCADIZ | | | | | | | | | | 52440 | | 23994 | 61530 | | 56276 | 2861 | | | 31267 | 22258 | 21593 | 24918 | 21918 | 31811 | 32696 | 32854 |

- No clear trend.
- Gaps.
- Probable drop after 2007-2009 high population levels?
- Very recent increase (2018-2020).
- Historical mean: 457 million fish, 34 463 t.

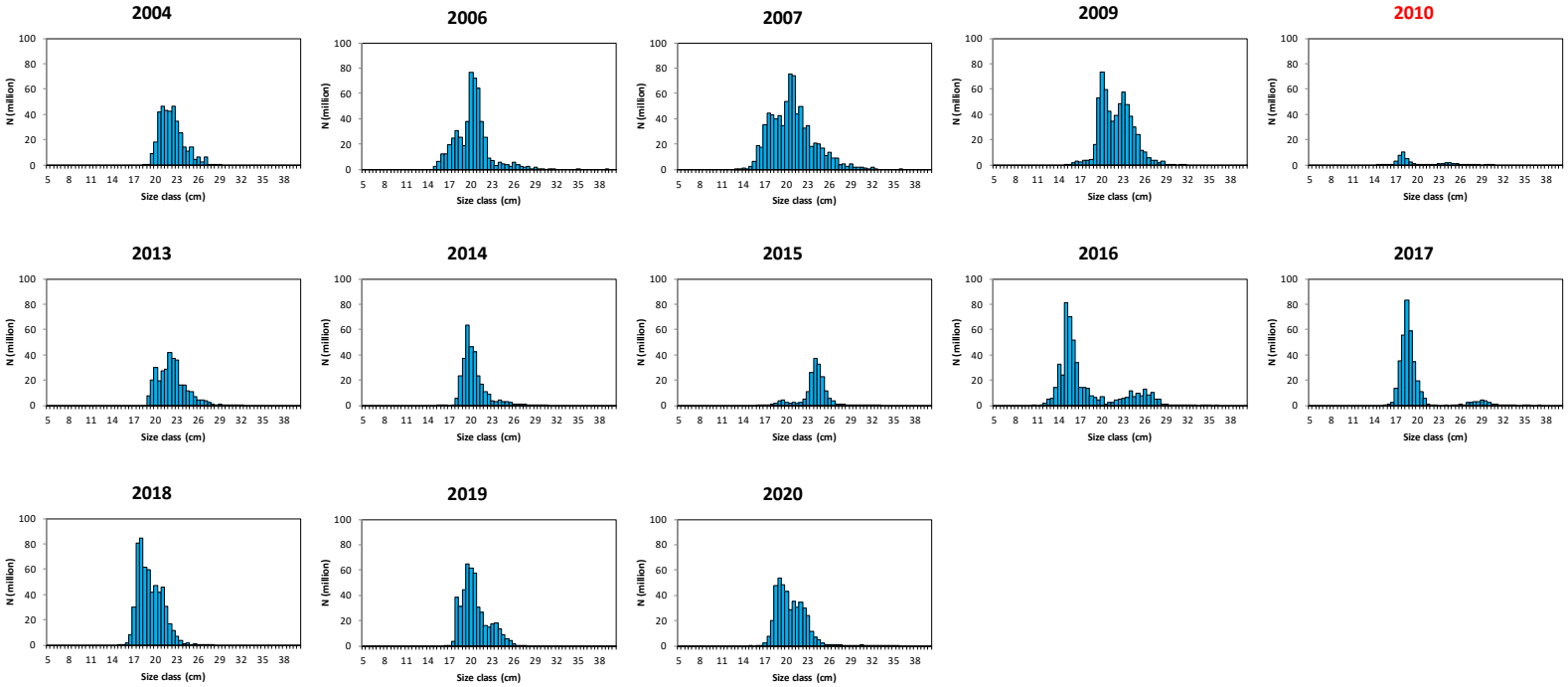
# ECOCADIZ & ECOCADIZ-RECLUTAS surveys series: historical series of N and B estimates. ECOCADIZ-RECLUTAS surveys series.



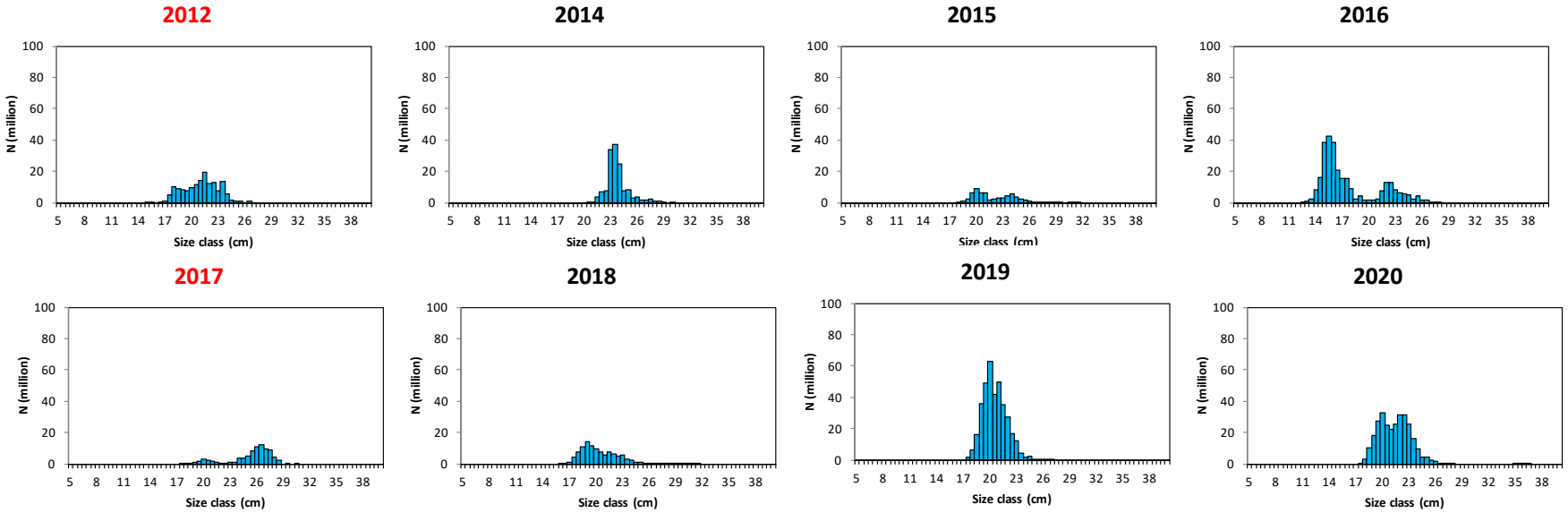

- No clear trend.
- Too short series.
- Very recent increase (2019-2020). Peak in 2019 (26 212 t).
- Historical mean: 214 million fish (less than in summer), 15 487 t.

# ECOCADIZ & ECOCADIZ-RECLUTAS surveys series: Population size composition. ECOCADIZ surveys series.



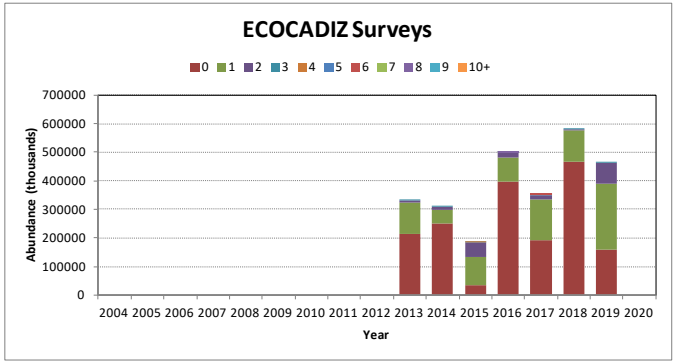

- Overall size class range: 10.5 – 39.0 cm.
- Frequent mixed LFDs: 2 modes (15.0-20.0 cm & 20.0-29.0 cm) with a different relative importance through the series.

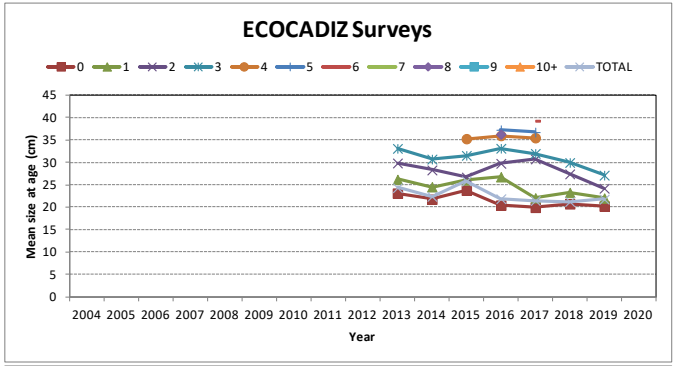
# ECOCADIZ & ECOCADIZ-RECLUTAS surveys series: Population size composition. ECOCADIZ-RECLUTAS surveys series.

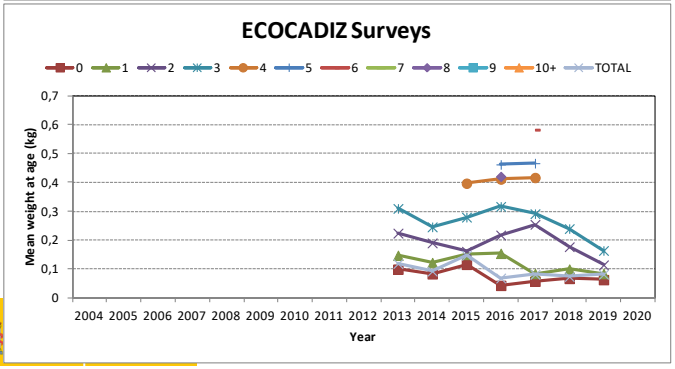



- Overall size class range: 12.5 – 36.5 cm.
- Unimodal LFDs: modes at 19.0, 20.0, 23.5 cm.
- Mixed LFDs in some years: 2 modes (15.5-20.0 cm & 22.0-24.0 cm), the smallest the dominant one.

# ECOCADIZ & ECOCADIZ-RECLUTAS surveys series: Population age structure. ECOCADIZ surveys series.

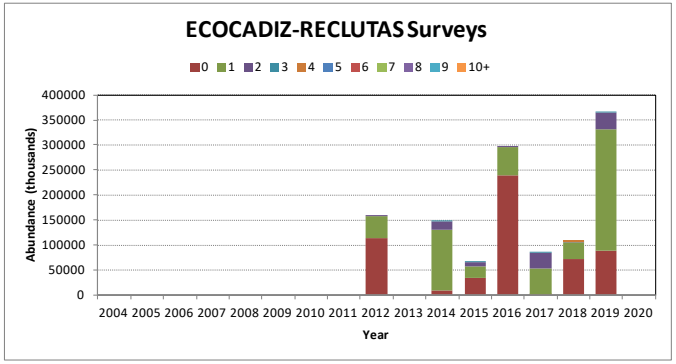


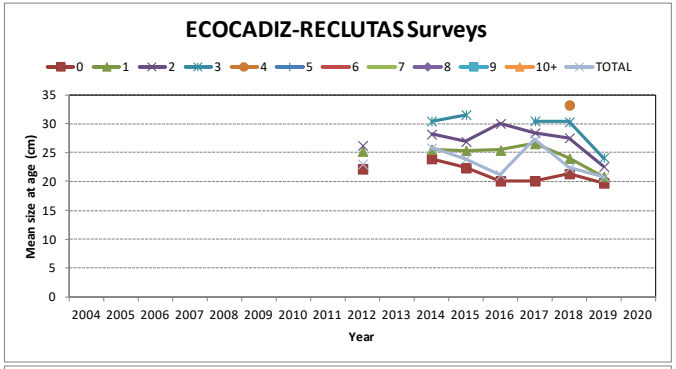



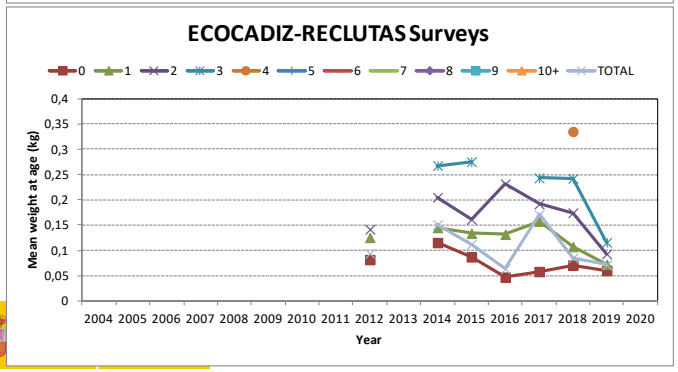




- Age structure in 2013-2018 surveys estimated by applying IEO's 8c-9aN ALKs.
- 2019 on: own surveys' ALKs.
- *ECOCADIZ 2020-07* ALK not yet available.
- Age 0 – Age 8 groups present in the population. Age 0 – Age 3 the main ones. Age 0 – Age 1 the most dominant (juveniles and young adults).
- Strong 2016 and 2018 year classes.
- Mean size (22,7 cm) and weight (95 g) of the population influenced by the dominant younger age groups.
- Recent decrease in the above population descriptors.

# ECOCADIZ & ECOCADIZ-RECLUTAS surveys series: Population age structure. ECOCADIZ surveys series.




- Age structure in 2012-2018 surveys estimated by applying IEO's 8c-9aN ALKs.
- 2019 on: own surveys' ALKs.
- *ECOCADIZ-RECLUTAS 2020-10* ALK not yet available.
- 2012 and 2017: incomplete survey coverage.
- Age 0 – Age 4. Age 0 – Age 2 the main groups. Age 0 – Age 1 the dominant ones.
- Age 1 dominant in autumn 2014. Not in the previous summer.
- Confirmed the strength of the 2016 and 2018 year classes.
- Mean size (22,8 cm) and weight (97 g) of the population influenced by the dominant younger age groups.
- Recent decrease in the above population descriptors.

# IEO's Acoustic Trawl surveys in Iberian-Atlantic waters : Concluding remarks.

- ***PELACUS*** (Spring; Cantabrian-North West, 8.c-9.a N):
  - No survey in 2020 (COVID-19 disruption).
  - 2019:
    - o VMA relatively common, but mainly occurring in 8.c East.
    - o Centre of gravity shifting towards the eastern part (8.c East) again in 2019 (In 9.a N in 2017).
    - o Peak in 2016. Decreasing trend since then. 2019: 48 millions, 7025 t.
    - o **Age 1**-**Age 3**-Age 7. Strong 2012, 2015 & 2016 cohorts.

- ***IBERAS*** (Autumn; Iberian Atlantic façade, 8.c West/9.a N/9.a C-N/9.a C-S):
  - 2020:
    - o VMA frequent. Wide but patchy distribution. Higher densities in 9.a C-S.
    - o Centre of gravity shifting towards the southern part again in 2020. "Hibernating" in southern areas?
    - o Aggregation patterns different to those observed ones in previous years. Changes in availability to the survey.
    - o Short series. Peak in 2019. 2020: 323 millions, 34 268 t.

- ***ECOCADIZ*** (Summer; GoC, 9.a S) & ***ECOCADIZ-RECLUTAS*** (Autumn; GoC, 9.a S):
  - 2020:
    - o VMA very common, both in summer and in autumn. Important species within the GoC "acoustic population".
    - o Preference for the inner and mid-shelf GoC waters, but specially those off the GoC Portuguese waters.
    - o Population levels not show any clear trend through their respective historical series. A peak in 2007-2009 summers? Some increased levels in relation to the historical average are observed in very recent years (2018-2019). Peak in autumn 2019 as in IBERAS. 2020 summer: 448 millions, 32 854 t; 2020 autumn: 295 millions, 22 918 t.
    - o **Age 0**-**Age 1**-**Age 2**-**Age 3**-Age 4-Age 8. Population mainly sustained by juveniles and young adults. Strong 2016 and 2018 year classes.

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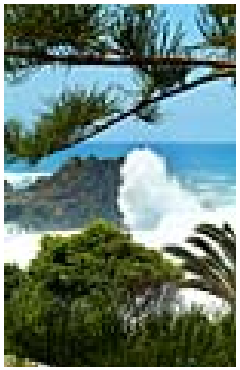
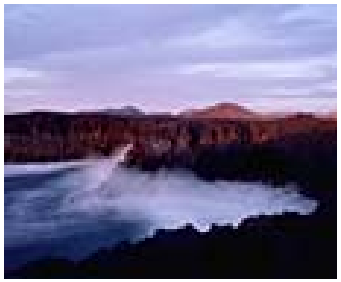
• Nakken, O., Dommasnes, A., 1977. Acoustic estimates of the Barent Sea capelin stock 1971-1976. ICES CM 1977/H:35, 6 pp. (mimeo).

# *Thanks*





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